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Project Title: Potential Methods of Round Goby Control in the Great Lakes

Project Category: Exotic Species

Rank by Organization (if applicable): 0

Total Funding Requested ($): 146,559 **Project Duration:** 2 Years

Abstract:

The most significant ballast water invader is certainly the zebra mussel. The natural history of the more recently invading round goby is intertwined with that of the zebra mussel because zebra mussels are a primary dietary component. The ability of gobies to use this previously underutilized food source may be, in part, responsible for their local abundance and rapid spread to all of the Great Lakes. They have decimated populations of mottled sculpins through disruption of spawning, and threaten other species by eating eggs. We have documented that there are disjunct distributions of gobies related to physical barriers (e.g., lakes in mid-river) and biological barriers (e.g., predators). This is a significant finding and indicates that there may be ways to control this species. Gobies may be vulnerable to control during their reproductive period, since few males develop to guard nests which appear to require certain unique characteristics. These bottlenecks suggest that we may be able to exploit this weakness and design nesting sites that could either kill the eggs if laid or lock the male inside. Therefore, we propose to investigate a multi-faceted, integrated pest management strategy for round gobies by managing their reproductive habitat and studying the ability of native predators and other factors ascertained from field studies, as control vectors. Based on our research and potentail impacts on lentic and lotic fishes, we need to: 1.) determine what barriers currently prevent the spread of gobies and why, 2.) determine which piscivores are better predators, and 3.) determine what type of spawning structures might be designed to reduce spawning success of gobies, while enhancing native species, such as mottled sculpin. Control and management actions depend on knowledge of what factors may limit their dispersal (e.g., low-head dams, predators) and how spawning structures may be designed to decrease goby spawning sucess, while enhancing native species.

Geographic Areas Affected by the Project

States:

- [x] Illinois
- [x] Indiana
- [x] Michigan
- [ ] Minnesota
- [ ] New York
- [ ] Pennsylvania
- [ ] Wisconsin
- [ ] Ohio

Lakes:

- [ ] Superior
- [x] Huron
- [x] Michigan
- [x] Erie
- [ ] Ontario
- [x] All Lakes

Geographic Initiatives:

- [ ] Greater Chicago
- [ ] NE Ohio
- [ ] NW Indiana
- [ ] SE Michigan
- [ ] Lake St. Clair

Primary Affected Area of Concern: Grand Calumet River/IHC, IN

Other Affected Areas of Concern:

For Habitat Projects Only:

Primary Affected Biodiversity Investment Area:

Other Affected Biodiversity Investment Areas:

Problem Statement:

Round gobies, like zebra mussels, have rapidly spread from the St. Clair River in 1990 to all five of the Great Lakes in 5 yr. They currently threaten the Mississippi River and may have already passed by the electrical barrier site in the Chicago Sanitary Canal proposed to stop their dispersal. They have penetrated into two inland lakes and two inland rivers, the latter through bait-bucket transfers. They have also been found in one brook trout stream to date in Canada. We documented their near extirpation of mottled sculpin at Calumet Harbor and in the St. Clair River. They have eaten adult trout-perch and larval white perch and probably have detrimentally impacted other benthic species, such as darters and logperch. In the Flint River, which has few zebra mussels, they decimated caddisflies on the rocks and we found fewer darters after their arrival. We found them out at 30 m in winter in Lake Michigan, which poses another threat to the slimy and deepwater sculpin, whose populations they now overlap. They eat large amounts of zebra mussels and may concentrate PCBs in food webs, and they interfere with sport fishing by stealing bait. Management agencies are struggling to find ways to control them and through our field research, we think there are barriers that have prevented their spread naturally and they may be vulnerable to alteration of spawning sites because they guard nests and only a few males are involved.

Therefore, we propose to investigate a multi-faceted, integrated pest management strategy for round gobies. The goal of our proposal is to determine the feasibility of controlling round goby abundance and dispersal by managing their reproductive habitat and studying the ability of native predators and other factors ascertained from field studies as control vectors. Our work will also yield insights into the types of habitat that are most vulnerable to round goby invasions. More specifically, we propose to investigate natural barriers, both physical and biological, to ascertain how effective they are in repelling round and tubenose gobies. We will do that by examining our existing datasets and sampling further to clarify how effective these barriers might be to thwart dispersal farther into Great Lakes tributaries and inland rivers and lakes. These water bodies are under threat from bait-bucket transfers, the suspected mechanism for how round gobies got inland to the Flint and Shiawassee Rivers, tributaries to Saginaw Bay. Second, we will perform a number of pond experiments with various fish predators, especially smallmouth and largemouth bass, and determine which predators are more efficient in consuming and thus dampening the spread of gobies in bodies of water. Lastly, we will experiment with various nest designs with the aim of designing one or more which will attract round gobies to spawn in them, thus losing their reproductive output. Other nests may be built that may favor mottled sculpins, thus helping them to rebound in the face of large numbers of round gobies.

Proposed Work Outcome:

This study proposes the following objectives to accomplish the goals of an integrated pest management plan for round gobies:

1. To determine if physical or biological factors in the field, such as presence of aquatic vetetation, turbidity, fish

community composition, land use characteristics, or low-head dams prevent or impede round and tubenose gobies from invading connecting waterbodies.

2. To determine if largemouth bass are better predators on round gobies than are smallmouth bass.

3. To determine if spawning structures can be designed to kill eggs or inhibit round goby reproduction while enhancing mottled sculpin spawning.

First, several sites have been observed during our sampling for current grants that have prevented the dispersal of round and tubenose gobies beyond a certain point. These sites include: Wolf Lake, Flint River ponds, Clinton River, Lower Rouge, Shiawassee Lake, low-head dams on the Raisin River, and there may be others. These sites bear additional investigation and some have not been sampled at all (Flint River ponds). We feel these sites can reveal important information about the field distribution of round and tubenose gobies that may allow us to suggest ways of curtailing the dispersal of gobies. To further investigate these sites, we will do extensive seining with a 5 m long x 1.4 m high bag seine with 6-mm bar mesh or a 17-m seine. Sampling will continue upstream for at least 1 km or until no round gobies are located.

Second, studies of predators will be conducted at two ponds located at the MDNR field station near the Clinton River, by Lake St. Clair. Sections of the ponds will be partitioned off with mesh netting into 5-m quadrats (four replicates); the bottom will be covered with pea gravel. Several half tiles will be placed in the quadrats to provide shelter for 20 round gobies, which are abundant in that area of the river and lake. Two naïve largemouth bass will be introduced into the quadrats after 2 days of acclimation by the round gobies. Largemouth or smallmouth bass will be placed in three of the quadrats and none in the fourth. A video camera will be placed within to tape predation events; after 2 days, the bass and gobies will be removed and predation rates noted.

Third, we propose two means of controlling reproduction: (1) habitat modification using small stones to cover sites that have abundant round goby nesting activity, and (2) develop artificial nesting sites for round gobies that are hyper-attractive and easily recovered so that eggs can be destroyed. We may be able to coat these nests with a surface toxic substance (antifouling paint?). We propose to test these strategies at the Flint, Shiawassee, and Calumet Rivers as well as in Lake Erie at Stone Laboratory, Put-in-Bay, Ohio. Hyper-attractive goby nest sites will have a range of appropriate surface areas and ceiling heights for egg attachment, a range of hole sizes, and a range of ceiling shapes. We will assess nest attractiveness by percent occupancy and number of eggs deposited. We will give a high priority to shelters that can be inexpensively constructed.

Our efforts are aimed at a pest management scheme by creating several tools to thwart or destroy round gobies, thereby preventing them from colonizing new areas and controlling them or at least reducing their numbers once they do reach a sensitive area deemed important enough to try some new techniques. The potential useful outcome of the research will come in the form of what barriers have been effective at preventing the dispersal of gobies into connecting waterbodies. These could be low-head dams, abundant aquatic vegetation, or large numbers of predators. Our research also indicates that a large number of potential predators have consumed round gobies, but it does not indicate which would be the most effective predator to stock to attempt to depress round goby abundance. Our pond experiments will address this question and provide answers for at least two species, the large and smallmouth bass; channel catfish will also be tested if there is time. Lastly, round gobies are vulnerable during their reproductive phase and some of the field work we have done has shown us what types of structures round gobies spawn in, what size the males are, and how abundant black spawning males are in an area. We think a strategy like the sterile male technique or the deployment of hyperattractive spawning structures can act to reduce the output of round gobies in a local area. Further adjustments may also allow species such as mottled sculpin, to be favored by these structures, while round gobies are excluded. This information will therefore provide a variety of techniques, some very expensive, some not so, to address a variety of situations where control of the round goby would be critical to protect some endangered species or other native species threatened by this new exotic fish.

Project Milestones:	Dates:
Project Start	01/2001
Sample natural and artifical barriers	05/2001
Conduct pond studies with predators	06/2001
Design & deploy artificial nest shelters	05/2001
Conduct pond studies with veg/predators	06/2002
Test "hyper-attractive" nests at sites	06/2002
Prepare reports/manuscripts	09/2002
Project End	12/2002

☐ Project Addresses Environmental Justice

If So, Description of How:

☐ Project Addresses Education/Outreach

If So, Description of How:

Gobies are a popular subject with the media, and we get calls often for interviews, slides, and other requests. We will continue to respond to these requests for information as received. We are contacted often in the field by individuals and carry along handouts and a specially designed round goby and mottled sculpin sample that we show to people and discuss our research. We also will work with university media relations people to provide outreach when we document substantial findings. We provide talks for lay people and at professional meetings as part of our continuing efforts to educate the public about the problems of exotic species.

Project Budget:

	Federal Share Requested ($)	Applicant's Share ($)
Personnel:	75,950	4,059
Fringe:	12,109	1,137
Travel:	4,000	0
Equipment:	0	0
Supplies:	5,000	0
Contracts:	0	0
Construction:	0	0
Other:	0	0
Total Direct Costs:	97,059	5,196
Indirect Costs:	49,500	2,650
Total:	146,559	7,846
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

GGLAS and the Office of the Vice President for Research will provide match for this study (see budget). Loyola University will provide match in the form of salary of 1 mm for John Janssen. We will also be using round goby distribution data for the large tributaries along Lake Erie; data will be provided by Roger Thoma, Ohio EPA.

Description of Collaboration/Community Based Support:

MDNR and other natural resource agencies are struggling with the expansion of gobies in several areas of the Great Lakes and are looking for guidance and ways to control the spread and impact of this species in sensitive areas. The Corps of Engineers is erecting an electrical barrier on the Mississippi River in an attempt to stop these fish from reaching the Mississippi River. They are soliciting additional ways to curtail their dispersal, besides the barrier. The Mt Clemens DNR station will provide the ponds for the predator experiments and collaborate with us in that part of the study. We will also work with Roger Thoma who has cooperated with us in the past in providing data, information, and findings on the distribution of round gobies related to the tributaries along Lake Erie.